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RECONSTRUCTION OF 3D FLOW STRUCTURES IN A CYLINDRICAL CAVITY WITH A ROTATING LID

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The flow in a cylindrical cavity with a rotating lid has been studied for many years, e.g. by Sørensen et al (2006). It contains general flow phenomena like vortex breakdown and in some cases the break down is accompanied by multihelix vortices (Okulov *et al*, 2010). This type of flow phenomenon is difficult to capture experimentally since the flow is fully three-dimensional and also varies in time. A measurement in a point or in a plane will by itself not give the full picture of the flow.

Measurement with Particle Image Velocimetry (PIV) analyzed with Proper Orthogonal Decomposition (POD) is a promising method of reconstructing the full three dimensional, time-varying flow structures. This has been attempted in Meyer *et al* (2008) and Meyer *et al* (2009). The analyzed measurements show both that the vortex breakdown in some cases is asymmetrical (rotating around the cylinder axis) and that the presence of helical vortices can be detected. However, the interpretation of the resulting flow still is done with an element of guessing on whether a specific variation is caused by an actual time variation of a structure or is caused by the rotation of a three-dimensional structure.

The present work will also be based on time-resolved stereoscopic PIV measurements in a vertical plane through the cylinder axis as shown in figure 1. Compared to Meyer *et al* (2008) the measurements will be expanded by adding measurements in several points outside the PIV data plane with a Laser Doppler Anemometer (LDA). LDA has a very good time resolution and the synchronized PIV and LDA measurements will therefore resolve the ambiguity in the interpretation of PIV data with respect to whether the flow variations are caused by rotation of a three-dimensional structure or is a real transient phenomenon.

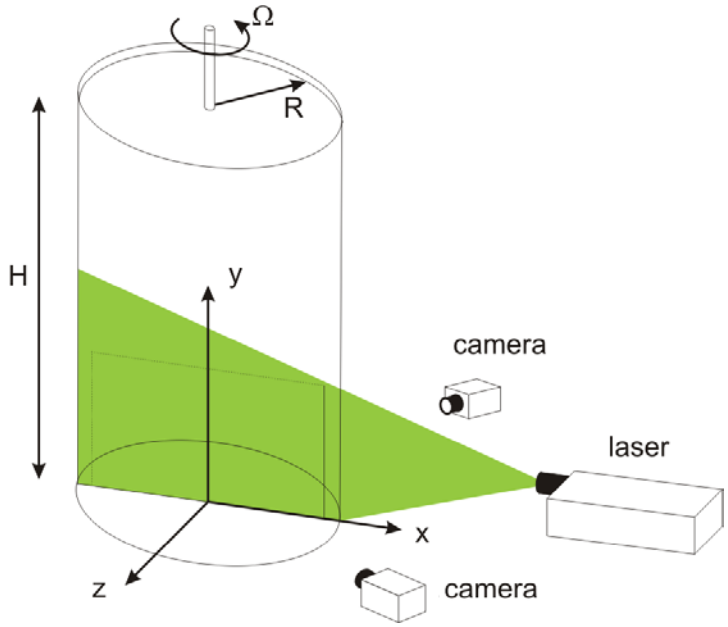

Figure 1: Sketch of setup for stereoscopic PIV measurement

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